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| 10/522,346 | 09/26/2005 | Fred Raymel Harris | 1505-65985-02 | 6309 |

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| EXAMINER | |
|---|---|
| MOWLA, GOLAM | |

| ART UNIT | PAPER NUMBER |
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| 1795 | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/522,346 | HARRIS ET AL. | |
| | Examiner | Art Unit | |
| | GOLAM MOWLA | 1795 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *10 August 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) *26-32* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 January 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *01/24/2005 and 08/21/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Election/Restrictions*

1. Applicant's election of Group I, claims 1-25, in the reply filed on 08/10/2009 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. Claim 1 recites "a composition, comprising: a first layer…and a second layer…". This is confusing. The claims recite a composition, but then claim a structure.

Claim 22 is indefinite because it recites the limitation "comprising $Bi_2Te_3$, $TiTe_2$ and $Sb_2Te_3$" in lines 1-2. It is not clear as to which layer comprises $Bi_2Te_3$, $TiTe_2$ and $Sb_2Te_3$. Examiner believes applicant's intention was to claim "the third repeating layer comprises at least one of $Bi_2Te_3$, $TiTe_2$ and $Sb_2Te_3$," and that is how it is interpreted.

### *Claim Rejections - 35 USC § 102*

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1-2, 4-7, 11-14, 16-18, 20 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Harman (US 5,900,071).

Regarding claims 1-2, 4-7, 11-14, 16-18, 20 and 22, Harman discloses a superlattice structure (10) (col. 6, lines 33-65 and col. 9, lines 14-42) comprising repeating or alternating units as shown in fig. 1, the repeating unit comprising a quantum well layer (14) (which reads on instant first layer) containing $Bi_2Te_3$ as the material having high power factor (col. 10, lines 58), and a quantum barrier layer (12) (which reads on instant diffusion barrier). Harman further discloses that the quantum well layer (14) contains 2 to 20 repeating monolayers (col. 9, lines 14-21), more specifically five monolayers with a total thickness of 19.645 angstroms ($d_B$= 1.9645 nm, with each monolayer being .3929 nm thick) (col. 7, lines 26-30), and the quantum barrier layer (12) contains 2 to 20 repeating monolayers (col. 9, lines 14-21), more specifically four monolayers with a total thickness of 14.768 angstroms ($d_A$=1.4768 nm, with each monolayer being .3692 nm thick) (col. 7, lines 26-30). Harman also discloses that the repeating unit has a thickness of 34.413 angstroms ($d_A$+$d_B$= 14.768 angstroms + 19.645 angstroms = 34.413 angstroms) (col. 7, lines 26-30).

***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

10. Claims 3, 8, 10, 15, 19, 21 and 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harman (US 5,900,071) as applied to claims 1, 5, 13 and 17 above.

Regarding claims 3, 8, 10, 15, 19 and 23-24, Applicant is directed above for complete discussion of Harman with respect to claims 1, 5, 13 and 17 above, which is incorporated herein. The reference is silent as to whether the diffusion barrier layer (12) comprises $TiTe_2$.

The reference further teaches that the quantum barrier layer is formed from material $L_{1-y}M_yD_zJ_{1-z}$, $0\leq x\leq 1$; $0\leq y\leq 1$; $0\leq z\leq 1$ (see col. 6, lines 46-65 and claim 1). With y=0 and z=1, the formula simplifies to $LD_z$, wherein L is transition elements and Group IIA elements (which reads on instant A), more specifically Eu, Sr, Ba or Ca, and D is group VIB elements (which reads on instant $Se_zTe_{2-z}$ with z being zero), more specifically Te, Se or S (see table on col. 6). Although he reference is silent as to whether A is Ti such that the barrier layer comprises $TiTe_2$, the reference explicitly shows that the A is transition metals. Ti is a known transition material and selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP § 2144.07. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized Ti as the transition material in the barrier material of Harman, because doing so only predictable results of interdiffusion reduction would have achieved.

Regarding claim 21, Applicant is directed above for complete discussion of Harman with respect to claim 6, which is incorporated herein. Harman further discloses that the repeating unit has a thickness of 34.413 angstroms ($d_A+d_B$= 14.768 angstroms + 19.645 angstroms = 34.413 angstroms) (col. 7, lines 26-30). Although the reference is silent as to whether the thickness of the repeating unit is from 40-100 angstroms, the reference explicitly discloses that the quantum well layer (14) and quantum barrier layer (12) contain two to twenty monolayers (col. 9, lines 14-21). Therefore, the thickness of

the repeating unit varies from 15.242 angstroms to 152.42 angstroms which is shown below:

| | Thickness of each monolayer (nm) | m=2 and n= 2 | m=20 and n= 20 |
|---|---|---|---|
| Quantum Well Layer | 0.3929 | 0.7858 | 7.8580 |
| Quantum Barrier Layer | 0.3692 | 0.7384 | 7.3840 |
| Total thickness (nm) | | 1.5242 | 15.2420 |
| Total Thickness (Angstroms) | | 15.242 | 152.42 |

Since the claimed range (40 to 100 angstroms) "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists (MPEP § 2144.05, *In re Wertheim*).

11. Claims 3, 15 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harman (US 5,900,071) as applied to claims 1 and 13 above, and further in view of Dye et al. (US 6214090 B1).

Regarding claims 3, 15 and 23, Applicant is directed above for complete discussion of Harman with respect to claims 1 and 13 above, which is incorporated herein. The reference further teaches that the quantum barrier layer is formed from material $L_{1-y}M_yD_zJ_{1-z}$, $0\leq x\leq 1$; $0\leq y\leq 1$; $0\leq z\leq 1$ (see col. 6, lines 46-65 and claim 1). With y=0 and z=1, the formula simplifies to $LD_z$, wherein L is transition elements and Group IIA elements (which reads on instant A), more specifically Eu, Sr, Ba or Ca, and D is group VIB elements (which reads on instant $Se_zTe_{2-z}$ with z being either zero or 2), more specifically Te, Se or S (see table on col. 6). The reference is silent as to whether A is selected from Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W and combinations thereof.

Dye teaches a diffusion barrier layer comprises $WSe_2$, which satisfies the instant claimed formula A $Se_zTe_{2-z}$ with A being W and z =2 (col. 4, lines 27-43).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized WSe2 of Dye as the barrier material in the superlattice composition of Harman in order to reduce interdiffusion as shown by Dye. In addition, selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP § 2144.07.

12. Claims 9 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harman (US 5,900,071) as applied to claims 5 and 17 above, and further in view of Tauchi et al. (US 2001/0017151 A1).

Regarding claims 9 and 25, Applicant is directed above for complete discussion of Harman with respect to claims 5 and 17 above, which is incorporated herein. The reference further teaches that the quantum well layer comprises BiTe3 (col. 10, line 58) and the quantum barrier layer is formed from material $L_{1-y}M_yD_zJ_{1-z}$, $0\leq x\leq 1$; $0\leq y\leq 1$; $0\leq z\leq 1$ (see col. 6, lines 46-65 and claim 1). With y=0 and z=1, the formula simplifies to $LD_z$, wherein L is transition elements and Group IIA elements (which reads on instant A), more specifically Eu, Sr, Ba or Ca, and D is group VIB elements (which reads on instant $Se_zTe_{2-z}$ with z being zero), more specifically Te, Se or S (see table on col. 6). Although the reference is silent as to whether A is Ti such that the barrier layer comprises $TiTe_2$, the reference explicitly shows that the A is transition metals. Ti is a known transition material and selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP § 2144.07.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized Ti as the transition material in the barrier material of Harman, because doing so only predictable results of interdiffusion reduction would have achieved.

The reference is silent as to whether at least a monolayer of quantum well layer (12) comprises $Sb_2Te_3$.

Tauchi teaches that $Bi_2Te_3$ and $Sb_2Te_3$ are art equivalence semiconductor materials that are used as thermoelectric material (col. 9, lines 3-12).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized $Sb_2Te_3$ semiconducting material instead of the $Bi_2Te_3$ semiconductor in the composition of Harman, as Tauchi explicitly recognizes the fact that $Bi_2Te_3$ and $Sb_2Te_3$ are art equivalence semiconductor material that are used as thermoelectric material (MPEP §2144.06 (II)).

***Correspondence/Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GOLAM MOWLA whose telephone number is (571) 270-5268. The examiner can normally be reached on M-F, 0900-1700 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ALEXA NECKEL can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./
Examiner, Art Unit 1795

/Jennifer K. Michener/
Supervisory Patent Examiner, Art Unit 1795